ARIZONA DEPARTMENT OF WATER RESOURCES
ENGINEERING & PERMITS DIVISION
Dam Safety Section

CHECKLIST OF ITEMS REQUIRED FOR A COMPLETE APPLICATION

Name of Dam: _____ Owner of Dam: _____

Application No._____ Date Filed: _____

[Application No. and Date Filed to be filled in by Arizona Department of Water Resources]

Instructions

This checklist is primarily applicable to significant and high hazard potential dams in accordance with Arizona Administrative Code (A.A.C.) R12-15-1208(A)(2), 1215 and 1216. All items and/or the designated level of design detail may not be required for all applications, including those for low and very low hazard potential dams in accordance with A.A.C. R12-15-1207(D), 1209, 1210, 1211, 1215 and 1216.

This guide, which identifies items required for a complete application, has been prepared to facilitate the applicant's understanding of the process. Any omissions or errors do not relieve the applicant from complying with applicable sections of Arizona Revised Statutes (A.R.S.) Title 45-Waters, Chapter 6 and A.A.C. Title 12–Natural Resources, Chapter 15–Department of Water Resources. The Director may require additional information, beyond the items delineated in this checklist, in accordance with A.R.S. §§ 45-1203(E) and 1206(A).

Complete the following checklist by indicating to the left that the item has been included and to the right its location(s) within the application documents. If a checklist item does not apply, indicate **N/A** and provide a supporting discussion. The checklist will be provided electronically via e-mail upon the applicant's request.

Example

Y	**Surface Water Diversion Plan - Details of the plan for control or diversion of surface water during construction, if required.**	**See Page 7 and Appendix C of the design report & Section 1036 of the specifications**

I. GENERAL ITEMS

_____	Application Form – Complete and submitted in duplicate. [Ref. A.R.S. §§ 45-1203(B), 1206(A); A.A.C. R12-15-1208(A)(1), 1209(E), 1210(A)(1), 1210(B)(1), 1211(A)(1)]	_____
_____	Fee –The fee is 2 percent of the total estimate of the project cost associated with construction of the dam and appurtenant works. Preliminary investigations and surveys, engineering design, supervision of construction and any other engineering costs shall be included in the project construction costs (refer to "Instructions for Filing an	_____

Application"). [Ref. A.R.S. § 45-1204; A.A.C. R12-15-104.A.7, 1208(A)(3), 1210(A)(2), 1210(B)(2), 1211(A)(4)]

_____ Two Sets (minimum) of Construction Drawings
[Ref. A.R.S. §§ 45-1203(A), 1206(A); A.A.C. R12-15-1208(A)(5), 1209(E)(1), 1210(A)(6), 1211(A)(6), 1215(1)]

_____ Two Sets (minimum) of Construction Specifications
[Ref. A.R.S. §§ 45-1203(A), 1206(A); A.A.C. R12-15-1208(A)(6), 1210(A)(7), 1215(2)]

_____ Two Design Reports (minimum)
[Ref. A.A.C. R12-15-1208(A)(7), 1210(A)(8), 1215(3)]

_____ Two Sets (minimum) of Construction Quality Assurance (CQA) Plan
[Ref. A.A.C. R12-15-1208(A)(8), 1210(A)(9), 1212(C), 1215(2)(e)]

_____ Two Sets (minimum) of Evidence of Financial Capability – Consists of a long-term budget plan and evidence of financing, prepared using customary accounting principles that demonstrate that the applicant has the financial capability to construct, operate and maintain the dam in a safe manner. [Ref. A.A.C. R12-15-1208(A)(10)]

_____ Two Sets (minimum) of the Construction Schedule
[Ref. A.R.S. §§ 45-1203(E), 1206(A)]

_____ Two Sets (minimum) of the Emergency Action Plan, Operation and Maintenance Plan, and Instrumentation Plan – These documents, if not ready for submittal with the application filling, may be submitted during construction. [Ref. A.R.S. § 45-1203(E); A.A.C. R12-15-1208(B), 1217, 1221]

_____ Drawings, Specifications, CQA Plan and Design Report Sealed by P.E.
The drawings, specifications, CQA Plan and design reports (each of which are described in detail below) must be prepared by a professional engineer registered in Arizona to a level of detail appropriate for construction. The design engineer must be experienced in the design and construction of dams. The engineer's seal and signature must appear on all drawings, specifications and engineering reports, and conform to the requirements of the Arizona State Board of Technical Registration. A preliminary review set of drawings submitted with the application may also be stamped "preliminary" and/or "not for construction" in accordance with the rules of the Arizona State Board of Technical Registration. [Ref. R4-304; A.A.C. R12-15-1215(1)(a), 1215(2)(a), 1215(3)(a)]

II. CONSTRUCTION DRAWINGS

Drawings should be prepared on conventional drafting material such that clear, legible prints can be obtained. Drawings must clearly present all details and dimensions required to construct the dam in accordance with the engineers design. Submittal of blue line prints, black line prints or mylar for final approval will be satisfactory. The following drawings should be included. List additional drawings in this section if applicable to the design. [Ref. A.A.C. R12-15-1208(A)(5), 1209(E)(1), 1209(F)(1), 1210(A)(6), 1211(A)(4), 1215(1)]

_____ Dam Safety Section Approval Block – In preparing the drawings, each sheet should contain the normal title block in the lower right hand corner as well as a space 2" high x 4" wide in proximity to the lower right hand corner for the Department's approval stamp.

_____ Topographic Map - A topographic map(s) of the dam, spillway, outlet works and reservoir on a scale large enough to accurately locate the dam and appurtenances, indicate cut and fill lines, and show property lines and ownership status of the land. Elevations must be to a national datum base, such as mean sea level, rather than an assumed elevation. Contour intervals must be compatible with the height and size of the dam and its appurtenances as required to provide adequate design and construction details. Horizontal control must be in accordance with the State coordinate system and/or per latitude and longitude. [Ref. A.A.C. R12-15-1215(1)(b)]

_____ Reservoir Area and Capacity Curves – The area-capacity curves shall reflect area in acres and capacity in acre-feet in relation to depth of water and elevation in the reservoir. The spillway invert and top of dam elevations must be shown. The reservoir volume/space functional allocations must also be shown. Alternate scales may be included as required for the owner's use. [(Ref. A.A.C. R12-15-1215(1)(c)]

_____ Spillway and Outlet Works Rating Curves and Tables - The spillway rating curve must be at a scale or scales which allow determination of discharge rate (cfs) at both low and high flows as measured by depth of water passing over the control section. [Ref. A.A.C. R12-15-1215(1)(d)]

_____ Location Map - A location map showing the dam footprint and all exploration drill holes, test pits, trenches, adits, borrow areas and bench marks with elevations, reference points and permanent ties. This map shall use the same vertical and horizontal control as the "topographic map." [Ref. A.A.C. R12-15-1215(1)(e)]

_____ Geologic Information – Geologic information including geologic map(s), profile along the centerline and other pertinent cross sections of the dam site, spillway(s) and appurtenant structures, aggregate and material sources, and reservoir area at scale(s) compatible with the site and geologic complexity, showing logs of exploration drill holes, test pits, trenches and adits. [Ref. A.A.C. R12-15-1215(1)(f)]

_____ Dam Plan – Plan(s) of the dam to adequately delineate design and construction details. [Ref. A.A.C. R12-15-1215(1)(g)]

_____ Foundation Profile - A foundation profile along the dam centerline at a

true scale (vertical=horizontal) showing the existing ground and proposed finished grade (cut and fill) elevations, including anticipated geologic formations. Include any proposed grout and drain holes. [Ref. A.A.C. R12-15-1215(1)(h)]

_____ Dam Profiles and Sections - A profile and a sufficient number of cross-sections of the dam to delineate design and construction details. Camber, crest details, interior filters and drains, and other zone details must be shown and dimensioned. The profile of the dam may be drawn to different horizontal and vertical scales if required for detail. A maximum section of the dam shall be included; it must be drawn to a true scale (vertical = horizontal). The outlet conduit may be shown on the maximum section if this is typical of the proposed construction. [Ref. A.A.C. R12-15-1215(1)(i)]

_____ Foundation Plan – Foundation plan(s) showing excavation grades and cut slopes with any proposed foundation preparation, grout and drain holes, and foundation dewatering requirements. [Ref. A.A.C. R12-15-1215(1)(j)]

_____ Outlet Works – A plan, profile and details of the outlet works, including the intake structure, the gate system, conduit, trashrack, filter diaphragm, concrete encasement and the downstream outlet structure. Include all connection and structural design details. [Ref. A.A.C. R12-15-1215(1)(k)]

_____ Spillway - A plan, profile, control section and cross sections of the spillway. Include details of any foundation preparation, grouting or concrete work that is planned. A complex control structure, a concrete chute or an energy-dissipating device for a terminal structure will require both hydraulic and structural design details. [Ref. A.A.C. R12-15-1215(1)(l)]

_____ Drainage Area – Hydrologic data, drainage area and flood routing criteria. [Ref. A.A.C. R12-15-1215(1)(m)]

III. CONSTRUCTION SPECIFICATIONS

The specifications must include a detailed description of the work to be performed and a statement of the requirements for the various types of material and installation techniques that will enter into the permanent construction. Of particular importance are those sections describing foundation preparation, placement of materials and material testing. Specifications must be complete and not cross-referenced to specifications in other documents. As a minimum, the following specifications should be included, when applicable, to the design. List additional specifications applicable to the design in this checklist. [Ref. A.A.C. R12-15-1208(A)(6), 1210(A)(7), 1211(A)(3), 1215(2)]

_____ Earthwork Specification – Include all earth and rock material descriptions, placement criteria and construction requirements for all elements of the dam and related structures. [Ref. A.A.C. R12-15-1215(2)(f)(i)]

_____ Concrete, Grout and Shotcrete Specifications – Include all concrete, grout and shotcrete material descriptions, placement and consolidation criteria, temperature controls and construction requirements for all elements of the dam and related structures. [Ref. A.A.C. R12-15-1215(2)(f)(ii)]

_____ Foundation Specification – Include acceptable material criteria and testing, cleaning and treatment. If foundation or curtain grouting is required, include the type of grout, grouting method, special equipment, recording during grouting and foundation monitoring to avoid disturbance from grouting. [Ref. A.A.C. R12-15-1215(2)(f)(iii)]

_____ Materials Testing – Include in each specification all materials testing to be performed by the contractor for pre-qualification of materials for use and acceptance of materials as constructed in place in accordance with specifications. Include all required special performance testing such as water pressure tests in conduits. [Ref. A.A.C. R12-15-1215(2)(f)(iv)]

_____ Control of Stream During Construction - A plan for control or diversion of surface water during construction. The frequency of storm runoff to be controlled during construction may be determined by the design engineer commensurate with the risk of economic loss during construction. [Ref. A.A.C. R12-15-1215(2)(f)(v)]

_____ Blasting – Criteria for blast monitoring and acceptable blast vibration levels (particle velocities), monitoring equipment and monitoring locations must be included for the dam and other vibration sensitive structures and equipment. [Ref. A.A.C. R12-15-1215(2)(f)(vi)]

_____ Instrumentation – Include material descriptions, placement criteria and construction requirements. Instrumentation should be required to be installed by experienced specialty subcontractors. [Ref. A.A.C. R12-15-1215(2)(f)(vii)]

Additional Specification:

_____ _____

_____

IV. DESIGN REPORT

A design report is required for all dams and appurtenant structures. The report should include a discussion and definition of the engineering consideration and conclusions incorporated in the design. The report must also include copies of pertinent calculations as appendices. As a minimum, the following sections should be included in the design report when applicable to the design. List additional sections applicable to the design report in this checklist. [Ref. A.A.C. R12-15-1208(A)(7), 1210(A)(8), 1215(3)]

_____ Classification – The classification under AAC R12-15-1206 of the proposed dam, or for the proposed enlargement of an existing dam and reservoir. [Ref. A.A.C. R12-15-1215(3)(b)]

_____ Hydrology – Hydrologic considerations, including calculations and a summary table of data used in determining the required emergency spillway capacity and freeboard, and design of any diversion or detention structures. Input and output listings (both hard copy and on diskette) of any computer programs used must be included. Include calculations for wave runup and wave setup in the reservoir as well as estimated sedimentation rates.
[Ref. A.A.C. R12-15-1215(3)(c)]

_____ Hydraulics - Hydraulic characteristics, engineering data and calculations used in determining the capacities of the outlet works and emergency spillway. Input and output listings (both hard copy and on diskette) of any computer programs used must be included. Technical references must support any complex hydraulic designs.
[Ref. A.A.C. R12-15-1215(3)(d)]

_____ Geotechnical Investigation – Geotechnical investigation and testing of the dam site and reservoir basin. Results and analysis of subsurface investigations including logs of test borings and geologic cross sections. [Ref. A.A.C. R12-15-1215(3)(e)]

_____ Blasting Plan – Guidelines and criteria for blasting to be used by the contractor in preparing the blasting plan. [Ref. A.A.C. R12-15-1215(3)(f)]

_____ Surface Water Diversion Plan - Details of the plan for control or diversion of surface water during construction. Include a discussion for the basis for selection of the frequency of storm runoff to be controlled during construction. [Ref. A.A.C. R12-15-1215(3)(g)]

_____ Dewatering Plan – Details of the dewatering plan for subsurface water during construction. [Ref. A.A.C. R12-15-1215(3)(h)]

_____ Materials Information – Testing results of earth and rock materials, including the location of test pits and the logs of these pits. Strength test results must be plotted and the strengths selected for use in stability analyses shown. [Ref. A.A.C. R12-15-1215(3)(i)]

_____ Grout Design – Discussion and design of the foundation grouting, grout curtain and grout cap based on foundation stability and seepage considerations. [Ref. A.A.C. R12-15-1215(3)(j)]

_____ Reinforced Concrete Design – Calculations and basic assumptions on loads and limiting stresses for reinforced concrete design. Input and output listings (both hard copy and on diskette) of any computer programs used should be included. [Ref. A.A.C. R12-15-1215(3)(k)]

_____ Stability Analysis – A discussion and stability analysis of the dam including appropriate seismic loading, safety factors and embankment zone strength characteristics. Analyses must include both short-term and long-term loading on upstream and downstream slopes. Input and output listings (both hard copy and on diskette) of any computer programs used should be included. Plots of critical failure surfaces as well as the zones and phreatic surface used in the analyses must be shown on the critical cross section of the embankment. [Ref. A.A.C. R12-15-1215(3)(l)]

_____ Seismicity – The seismicity of the project area and activity of faults in the vicinity must be discussed. Both deterministic and statistical methods must be utilized and the appropriate seismic coefficient identified for use in analyses. [Ref. A.A.C. R12-15-1215(3)(m)]

_____ Cutoff Trench Design - Discussion and design of the cutoff trench based on seepage and/or other considerations. [Ref. A.A.C. R12-15-1215(3)(n)]

_____ Seepage – Permeability characteristics of foundation and dam embankment materials, including calculations for seepage quantities through the dam, the foundation and anticipated in the internal drain system. Input and output listings (both hard copy and on diskette) of any computer programs used should be included. Copies of flow nets, if utilized, must be included. [Ref. A.A.C. R12-15-1215(3)(o)]

_____ Internal Drainage – Discussion and design of internal drainage based on seepage quantity calculations. Include instrumentation necessary to monitor the drainage system and filter design calculations for protection against piping of foundation and embankment materials. [Ref. A.A.C. R12-15-1215(3)(p)]

_____ Erosion Protection – Erosion protection against waves and rainfall runoff must be provided for both the upstream and downstream slopes, as appropriate. [Ref. A.A.C. R12-15-1215(3)(q)]

_____ Dam Foundation Treatment and Abutment Contact Design, and Spillway Foundation Design - Discussion and design of foundation treatment to adequately compensate for geological weakness in the dam foundation and abutment areas, and in the spillway foundation area. [Ref. A.A.C. R12-15-1215(3)(r)]

_____ Post-construction Vertical and Horizontal Movement Systems [Ref. A.A.C. R12-15-1215(3)(s)]

_____ Foundation Conditions – Discussion of foundation conditions including the potential for subsidence, fissures, dispersive soils, collapsible soils and sinkholes. [Ref. A.A.C. R12-15-1215(3)(t)]

_____ Additional Report Section:

_____ Additional Report Section:

V. CONSTRUCTION QUALITY ASSURANCE PLAN

A Construction Quality Assurance (CQA) Plan is required for all dams and appurtenant structures. A statement of the designer's requirement with regard to construction testing frequencies, foundation preparation guidelines, etc., must be included in the CQA Plan to facilitate the construction in conformance with the plans and specifications. As a minimum, the CQA Plan should include the following sections: [Ref. A.A.C. R12-15-1208(A)(8), 1209(E)(3), 1210(A)(9), 1212, 1213]

_____ Delineation of Responsibilities and Authority – The responsibilities and lines of authority of the organizations involved in the construction of the dam must be described. The role of pre-construction, progress and problem or work deficiency meetings should be discussed. [Ref. A.A.C. R12-15-1212(A)]

_____ Third Party Testing – The CQA Plan should detail the responsibilities of third party (independent of the contractor) field and laboratory testing by a registered engineer for all elements of the dam and related structures. [Ref. A.A.C. R12-15-1212(B)]

_____ Statement of Qualifications – The CQA Plan should identify the training and experience of the CQA personnel, field supervisors and engineer of record. This information should document their ability to fulfill their assigned roles. [Ref. A.A.C. R12-15-1212(C)]

_____ Inspection and Testing Activities - The CQA Plan should specify the

inspection, testing and sampling activities to be implemented for all elements of dam construction. The CQA Plan should identify key inspection items that require the Department's approval. [Ref. A.A.C. R12-15-1212(A), 1212(D), 1212(G)]

_____ Acceptance and Rejection Criteria - The acceptance or rejection criteria for inspection and testing activities should be clearly stated. The CQA Plan should describe procedures for documenting corrective measures and design changes that require prior approval by the Department. [Ref. A.A.C. R12-15-1212(E), 1212(F)]

_____ Documentation Requirements - The CQA Plan should include requirements for the submittals of as-built drawings and a completion report, which are required prior to the issuance of a license. [Ref. A.A.C. R12-15-1213]

VI. CONSTRUCTION SCHEDULE

_____ Construction Schedule - A statement of the anticipated sequence and duration of construction operations must be filed in duplicate with the application. [Ref. A.R.S. § 45-1203(E)]

VII. OPERATION AND MAINTENANCE PLAN

An Operation and Maintenance (O&M) Plan must be prepared for all dams and their appurtenant structures. The O&M Plan must specify the frequency of inspections and maintenance of the dam and appurtenant structures. The frequency for exercising any mechanical or electrical equipment or systems must also be specified. Equipment must be exercised and inspected at least once each year. The frequency of inspections for submerged facilities such as intake structures or outlet pipes must also be specified. More frequent inspections and operation may be required depending on the size of the dam or reservoir, hazard classification or condition of the dam. The O&M Plan must specifically address the following: [Ref. A.R.S. § 45-1212; A.A.C. R12-15-1205(D), 1208(B)]

_____ Dam Structure (Earth & Rockfill) – Settlement, slides, depressions, misalignment, cracking (transverse and longitudinal), burrowing animals, erosion, seepage and adequacy of slope protection.

_____ Dam Structure (Concrete & Masonry) – Cracking, spalling, scaling, joint displacement or offsets, foundation and abutment contacts displacement or offset, seepage and adverse vegetation.

_____ Metal Surfaces – Corrosion, deficient protective coatings, misaligned or split seams. Includes gates, stairs and ladders, handrails, pipe, drainage culverts, instrumentation pipes or hardware, drainage culverts, bridges, etc.

_____ Spillways – Spillway control structures (gates, concrete sills, flash boards, etc.), approach channels, main channels, stilling basins and energy dissipaters.

_____ Outlet Works – Includes buildings or structures that enclose the outlet works and submerged facilities such as intake structures.

_____ Downstream Channel Areas – Sloughing, eroding or backcutting, obstructions, adequacy of erosion protection and tailwater, and flow conditions.

_____ Reservoir Rim Area – Areas susceptible to slides or major rock falls that could result in overtopping of the dam or significant releases.

_____ Site Security – Fencing, surveillance cameras, security patrols, etc.

_____ Instrumentation – Description of the instrumentation system(s) that is part of the performance monitoring system for the dam and all appurtenant structures. The O&M Plan must clearly separate instruments and reading frequencies for the following conditions: (a) during construction, (b) immediately following completion of construction, (c) until initial reservoir fill is completed, and (d) long term monitoring. Vertical and horizontal movement monitoring of the dam must be performed, as a minimum. The design, construction and geological conditions of the dam may require other instrumentation, such as monitoring wells, piezometers, inclinometers, pressure cells, extensometers, crack monitors, seepage or drainage monitors, and strong motion (seismograph).

_____ Log Book - A logbook must be maintained for the life of the dam. The logbook must be part of the dam's permanent records and must be used to document each inspection, maintenance work performed and record of equipment operation (exercising). Each entry in the logbook must include the date, a description of the inspection and operation or maintenance work done, and shall be signed by the responsible person. Dates when instrumentation readings are taken and person taking readings must be recorded in the logbook.

_____ Annual Report – The owner or operator providing an annual report to ADWR, Office of Water Engineering, must list all inspections made, maintenance work performed, instrumentation data collected and dates of same. The report must include an interpretation of the instrumentation data by a person qualified to evaluate the data of the dam's performance. The report must include the significance of the instrumentation data and a discussion of planned maintenance or repairs at the dam.

_____ Photographic Record - The owner or operator maintaining complete photographic record of sufficient detail that would typically show the extent of cracks in concrete, erosion of embankments or condition of metal parts. Photos must be taken on a five-year interval (minimum) and must be maintained for the life of the dam. A complete set of the photos (minimum 3 1/2 x 5 inches in size) must be provided to ADWR when taken and included as part of the annual report for that year.

VIII. EMERGENCY ACTION PLAN

Dams classified as having high or significant downstream hazard potential must file an Emergency Action Plan (EAP) including a dam breach inundation map. The EAP must be filed in duplicate and, at a minimum, include the following elements: [Ref. A.A.C. R12-15-1221]

_____ Notification Flow Chart – The EAP should include a chart showing the hierarchy for notification in an emergency situation, including priority of notifications. Notifications should include local emergency response agencies, affected downstream populations, county emergency management agencies and affected flood control districts. [(Ref. A.A.C. R12-15-1221(A)(1)]

_____ Statement of Purpose – The EAP must describe the project and scope of the EAP. [Ref. A.A.C. R12-15-1221(A)(2)]

_____ Emergency Detection, Evaluation and Action - The EAP must delineate the type of potential unsafe conditions, evaluation procedures and triggering events that require the initiation of partial or full emergency notification procedures based on the urgency of the situation. [Ref. A.A.C. R12-15-1221(A)(3)]

_____ Responsibilities – The EAP should delineate areas of responsibility, particularly the owners, to ensure effective and timely action. The individuals responsible for notifications and declaring an emergency must be clearly identified. [Ref. A.A.C. R12-15-1221(A)(4)]

_____ Notification Procedures – The EAP should be specific for each emergency situation that is anticipated. [Ref. A.A.C. R12-15-1221(A)(5)]

_____ Preparedness - The EAP should identify emergency supplies and resources, equipment access to the site and alternative means of communication. The EAP should also identify specific preparedness activities required such as annual full or partial mock exercises and updates of the EAP. [Ref. A.A.C. R12-15-1221(A)(6)]

_____ Inundation Map – An inundation map should show the area that would be subject to flooding due to spillway flows and dam failure. [Ref. A.A.C. R12-15-1221(A)(7)]

IX. OTHER PERMITS

It is not unusual that additional permits from this and/or other government agencies may also be required before construction may commence. Several other permits are described below. It is the responsibility of the owner to obtain all permits required for construction.

_____ State Trust Land - If the dam is to be constructed on, any materials for the dam to be borrowed from or the reservoir will inundate State Trust Land; contact the State Land Department at (602) 542-4621 for details of their requirements.

_____ Federal Land - If the dam is to be constructed on, any materials for the dam are to be borrowed from or the reservoir will inundate federal land, contact the appropriate federal agency for details of their requirements.

_____ Water Rights - If surface waters are to be impounded, contact the Arizona Department of Water Resources, Office of Water Engineering, at (602) 417-2445 for details.

_____ Corps 404 Permit – Any significant work in or affecting a stream may require a A404 Permit. Contact the U.S. Army Corps of Engineers for details.

_____ Corps 401 Certification - A 401 Certification from the Arizona Department of Environmental Quality is required before a 404 Permit can be obtained to ensure that federal activities do not violate state water quality standards.

_____ Geotechnical Exploration Holes, Monitoring and Piezometers Wells - Certain types of drilled holes require permits and/or must be abandoned in accordance with prescribed procedures. For details, contact the Arizona Department of Water Resources, Groundwater Management Support Section, (602) 417-2470.